

SPATIAL AND TEMPORAL VARIABILITY OF NITROGEN RESPONSE IN GRAIN SORGHUM

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ABSTRACT

Nitrogen (N) response in grain sorghum is spatially and temporally variable, complicating estimation of optimum N rates and limiting the effectiveness of uniform fertilizer recommendations. This study evaluated within-field and year-to-year variability in N response using block-level response modeling and soil variability analysis. Field experiments were conducted in Stillwater, Oklahoma, during the 2024 and 2025 growing seasons using six N fertilizer rates (0, 39, 79, 118, 157, and 196 kg N ha⁻¹). Yield response curves were fitted at the block level and classified into response types, and soil physical and chemical properties were summarized using interquartile range (IQR) analysis. Nitrogen responsiveness differed substantially between years, with lower and more variable optimum N rates and yield potential observed in 2024 compared with 2025. The relationship between optimum N rate and yield potential was not significant in either year, indicating that N_{opt} alone did not explain yield variability. Soil texture, salinity, aggregate stability, and penetration resistance differed among N response classes, highlighting the role of within-field soil variability in shaping N response behavior. These results demonstrate that classifying N response by response type, combined with spatial and soil variability analysis, provides additional insight beyond optimum N rate alone and supports the development of site-specific nitrogen management strategies.